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<p style="text-align: center;">Title</p> <p style="text-align: center;">Study on information hiding to digital audio</p>		
<p><b>Abstract</b></p> <p>Recent development of a digital-communications network and information processing technology enabled us to utilize information transmission of broadband capabilities. The information transmission using the broadband digital communications network is indispensable in digital society. But, the digital signals are easily copied out with any permission, widely distributed without the degradation if it is transmitted using a network. Thus a serious problem has arisen such as information security of the digital communication.</p> <p>As the countermeasure, the cryptographic technology can be introduced to protect the contents of information. However, this method is apt to have some illegal attacks. Furthermore, the fact of existence of cryptogram become a useful information to open the contents by attacker. On the other hand, a new social problem on copyright protection for multimedia contents will occur when these are released in illegal copy. The illegal copy can be prevented by using the seal and encryption schemes as the type of multi-media. But it is not possible to prevent the illegal access to decoded contents. Some of utilization restriction are not desirable from the viewpoint of expanding the market of digital contents.</p> <p>The information hiding technique is introduced to resolve this problem, recently. It is to embed some information into the digital contents so that any user may not perceive it in advance while the contents are circulated, and is to activate the embedded data to get the secret message or copyright information.</p> <p>The doctoral thesis consist of 17 chapters, i.e., Chapter 1, Part I,II and Chapter 17. Chapter 1 describes the outline of information hiding technique to digital audio. Part I proposes several schemes of steganography and Part II does the ones of watermarking, finally Chapter 17 is a conclusion.</p> <p>The 1st part contains the technology of steganography that is not the cryptography. It has an important characteristic that conceals the existence of information. While we are talking on telephone, for example, a secret message can be embedded to the talking channel, simultaneously, and would be extracted by the specified receiver. On the other hand, a third party can not detect the existence of this embedded messages even if only transmission data would be observed on the channel. It is interested in the steganography that the existence of the secure</p>		

communication can be concealed. Part I is constituted with 8 chapters from Chap.2 to Chap.9. Chapter 2 presents a basic embedding scheme to the adaptive quantization PCM voice code which is a popular fundamental compression procedure in the world. Chapters 3 to 6 describe some information hiding techniques based on the procedure of the international standard of the ITU-T. The scheme for applying the spread spectrum technique without deterioration of the music quality is proposed in Chapter 7 and the scramble system for improving the secure performance is shown in Chapter 8, respectively. In Chapter 9, the embedding technology to Standard MIDI File(SMF) is proposed, and the principle to prove the original version is discussed.

The watermarking scheme embeds information in Part II such as the copyright, where users can not perceive it in the digital contents, and it is used to try a proof of illegal copy. The embedded information is important in steganography but the watermarks are the secondary information and should not deteriorate the contents in the watermarking. The robustness against any attack is essential to the watermarking, since its purpose can not be achieved when the embedded information is lost by attack. Consideration about media quality and watermark robustness has to be discussed to design the watermarking scheme. Part II is constituted with 7 chapters from Chap.10 to Chap.16. Chapter 10 describes a robust technique based on the procedure of the spread spectrum system using the direct sequence method with sub-banding. Chapter 11 describes the technique based on the procedure of the frequency hopping, and it is different from the direct sequence method in the spread spectrum system, elementally. Chapter 12 describes the watermarking of statistical scheme at the frequency domain using the differential spreading method. In Chapter 13, the mutual relationship of audio data in two-dimensional array is utilized for the detection of watermarking. In Chapter 14, the concept of the candidate key is introduced for the inspection policy reacting to the embedded watermark. In Chapter 15, the variable watermarking scheme is investigated for trial listening system in the Internet commerce. In Chapter 16, the watermarking technology for the SMF is shown and a weak noisy operation is described for trial listening system in application format to music commerce.

Through these studies, it is clear that a number of important messages can be secretly embedded for various types of digital audio data. As the results, the effective guideline has been obtained for the development of information hiding techniques by using the digital communication.